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CLAIMS

[Claim(s)]
[Claim 1] The image display device characterized by building in the thin film loudspeaker which has flexibility.
[Claim 2] The above-mentioned thin film loudspeaker is an image display device according to claim 1 characterized by using a piezoelectric film as a diaphragm.
[Claim 3] The above-mentioned thin film loudspeaker is an image display device according to claim 2 characterized by sticking an electrode sheet on both sides of a piezoelectric film.
[Claim 4] The image display device according to claim 3 characterized by the sheet resistance of the above-mentioned electrode sheet being below 10ohms / **.
[Claim 5] The image display device according to claim 1 characterized by the thickness of the above-mentioned thin film loudspeaker being 1cm or less.
[Claim 6] The image display device according to claim 1 characterized by coming to arrange a pixel and said substrate having flexibility on a substrate.
[Claim 7] The image display device according to claim 6 characterized by the above-mentioned substrate consisting of plastic film.
[Claim 8] The image display device according to claim 6 characterized by having an opening between the above-mentioned thin film loudspeaker and the above-mentioned substrate.
[Claim 9] Spacing of the above-mentioned thin film loudspeaker and the above-mentioned substrate is an image display device according to claim 8 characterized by being 1cm or less.
[Claim 10] The above-mentioned pixel is an image display device according to claim 6 characterized by being constituted by the organic electroluminescent element.
[Claim 11] The above-mentioned organic electroluminescent element is an image display device according to claim 10 characterized by coming to carry out the laminating of the 1st electrode, an organic luminous layer, and the 2nd electrode one by one at least.
[Claim 12] The image display device according to claim 11 characterized by allotting the electron hole transportation layer to the electrode side used as the anode plate of the above-mentioned organic luminous layer.
[Claim 13] The image display device according to claim 11 characterized by allotting the electronic transportation layer to the electrode side used as the cathode of the above-mentioned organic luminous layer.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the flexible display using the substrate which has flexibility especially about an image display device.
[0002]
[Description of the Prior Art] In recent years, research on the flexible display using flexible substrates, such as plastics, is advanced. The flexible display board which carried out the laminating of a gas barrier layer or the transparence conductive layer to transparence plastic film, for example in JP,2000-338901,A etc. as a substrate of this flexible display is indicated. The flexible display has a predominance in lightweight nature, thinness, flexibility, etc. as compared with the display which used the conventional glass substrate, and even if convenient to carry and the wall to fix are curved surfaces, it has advantages, such as being satisfactory.
[0003]
[Problem(s) to be Solved by the Invention] By the way, when using such a flexible display as an image display device-cum-a speech generation device which reproduces voice with an image like a television receiver, the loudspeaker which is sound equipment for generating voice is required.
[0004] Here, as a conventional loudspeaker configuration, although the so-called funnel-like cone mold, a spherical-surface-like dome mold, etc. are common, when it is going to build these loudspeakers in an above-mentioned flexible display, there is a possibility of spoiling the lightweight nature and flexibility which are the advantage of a flexible display. Moreover, when a loudspeaker is made external, carrying etc. is troublesome and there is also a possibility of installing in a curved-surface-like wall becoming difficult and spoiling a fine sight.
[0005] This invention is proposed in view of this conventional actual condition, and it aims at offering the loudspeaker built-in image display device (flexible display) in which lightweight-izing and thin-shape-izing are possible, without spoiling flexibility. Moreover, this invention is easy to carry and it aims at offering the image display device (flexible display) which can be installed also in a curved-surface-like wall.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the image display device of this invention is characterized by building in the thin film loudspeaker which has flexibility. A thin film loudspeaker is lightweight and thin while it has flexibility. By making the thin film loudspeaker which has such a description rival in an image display device (flexible display), flexibility is maintained, image display is possible and the image display device which can also reproduce audio is realized by coincidence. Moreover, taking advantage of the advantage of being thin, lightweight-izing and thin-shape-izing of a display with a built-in loudspeaker are attained by the light weight of a thin film loudspeaker. Since the image display device of this invention contains the thin film loudspeaker and it is not necessary to make a loudspeaker external, carrying is easy. Furthermore, since the flexibility of the image display device itself is maintained, it can install in a curved-surface-like wall etc.

[0007]
[Embodiment of the Invention] Hereafter, the image display device which applied this invention is explained to a detail, referring to a drawing. In addition, although this invention can be applied to various flat-panel displays, such as a liquid crystal display, a plasma display (PDP), an organic electroluminescence display (organic electroluminescence), and a field emission display (FED), an organic electroluminescence display is made into an example and it explains it here.
[0008] Generally the organic EL device used for an organic electroluminescence display is constituted considering the transparent electrode layer on the transparence substrate which has light transmission nature, the organic luminous layer which is formed on this transparent electrode layer and consists of an organic electroluminescence ingredient, and the cathode electrode layer further formed on this organic luminous layer as a fundamental component, and since it has the descriptions, like visibility is high because of a spontaneous light type, it attracts attention as a light emitting device in various displays. In this organic EL device, the electron hole and electron which were poured in from each electrode by the energization to these transparent electrode layer and a cathode electrode layer recombine within an organic luminous layer, and produce luminescence with the energy at this time. Since said luminescence is light emitting diode and similar impregnation luminescence, it is the description that a luminescence electrical potential difference is as low as less than [10V].
[0009] Drawing 1 and drawing 2 show an example of the flexible display which applied this invention. This flexible display makes the thin film loudspeaker 3 come to rival in the both-sides section of the transparence substrate 1 with which laminating formation of the pixel display layer 2 was carried out. The thin film loudspeaker 3 vapor-deposits the electrode layers 3b and 3c which become both sides of piezo film 3a from aluminum etc., and has good flexibility in itself. Thus, since the transparence substrate 1 or not only the pixel display layer 2 but the thin film loudspeaker 3 has flexibility, flexibility good as a whole is maintained, and the flexible display of this example is lightweight, and is thin, and can be stuck on a curved-surface-like wall etc.
[0010] The above-mentioned thin film loudspeaker 3 vapor-deposits the electrode layers 3b and 3c which consist of aluminum etc. as shown in both sides of piezo film 3a shown in drawing 3 (a) at drawing 3 (b), as stated also in advance. Piezo film 3a is one sort of the piezoelectric film to which the configuration is changed by impressing an electrical potential difference. Here, as for piezo film 3a to be used, it is desirable from playing the role of the diaphragm of a loudspeaker a lightweight thing, especially that thickness is a low consistency thinly. If piezo film 3a is heavy, the imitation nature in a high frequency will worsen. Therefore, PLZT (Pb-La-Zr-Ti system electrostrictive ceramics), the electrostrictive ceramics of LiNbO3 and Bi12Si20 grade, etc. can be used for piezo film 3a. The outstanding loudspeaker of a property can be obtained by forming these electrostrictive ceramics in a uni-morph mold or a bimorph mold at the thin film of glass or plastics.
[0011] Moreover, it is required that the electrode layers 3b and 3c formed as an electrode should have a good electrical property, and electric resistance should be low. Specifically, it is desirable to make the electric resistance of these electrode layers 3b and 3c into below 10ohms / **. If electric resistance is higher than this, driver voltage will go up by the voltage drop, and it will become low effectiveness.
[0012] On the other hand, as shown in drawing 4 , on the transparence substrate 1 which has flexibility, the pixel display 2 is constituted by carrying out sequential membrane formation of the transparent electrode layer 21, the organic electroluminescence layer 22, and the cathode electrode layer 23, and these each class is covered in the gas barrier layer 24, and it is protected from moisture, corrosive gas, etc. The transparence substrate 1 consists of transparence plastic material, such as a polycarbonate and polyethylene terephthalate (PET), etc., and has good flexibility. The above-mentioned transparent electrode layer 21 is formed by forming membranes on this, for example, forming an indium oxide tin (ITO) thin film by the spatter.
[0013] The organic electroluminescence layer 22 is made into the three-tiered structure as shown in drawing 5 , and it consists of electronic transportation layer 22c allotted to the side which touches electron hole transportation layer 22a allotted to the side which touches the above-mentioned transparent

electrode layer 21, organic luminous layer 22b, and the above-mentioned cathode electrode 23. In addition, in the above-mentioned configuration, the buffer layer may be formed between the organic electroluminescence layer 22 and the cathode electrode 23. It is formed by forming for example, Li2O by about several angstroms thickness, and this buffer layer can lower luminescence starting potential by this buffer layer.

[0014] Electron hole transportation layer 22a plays the role of conveying the electron hole poured in from the transparent electrode layer 21 to organic luminous layer 22b, among the organic electroluminescence layers 22. As an electron hole transportation ingredient used for this electron hole transportation layer 22a Each well-known thing is usable. Benzine, a styryl amine, A triphenylamine, a porphyrin, triazole, an imidazole, OKISA diazole, the poly aryl alkane, a phenylenediamine, arylamine, oxazole, an anthracene, and full -- me -- non, a hydrazone, and a stilbene -- Or the monomer of heterocycle type conjugated system, such as a polysilane system compound, a vinylcarbazole system compound, a thiophene system compound, and an aniline system compound, oligomer, a polymer, etc. are usable in these derivatives and a list. As a concrete compound, alpha-naphthylphenyl diamine, a porphyrin, A metal tetra-phenyl porphyrin, metal naphthalocyanine, 4 and 4, 4-tris (3-methylphenyl phenylamino) triphenylamine, N, N, N, and N-tetrakis (p-tolyl) p-phenylene diamine, Although the N, N, N, and N-tetra-phenyl 4, 4-diamino biphenyl, N-phenyl carbazole, a 4-G p-tolylamino stilbene, Pori (PARAFENIREMBINIREN), Pori (thiophene vinylene), Pori (2 and 2-thienyl pyrrole), etc. can be mentioned Of course, it is not limited to these.

[0015] The ingredient used for organic luminous layer 22b moves that a cathode side to an electron can be poured in for an electron hole again and the poured-in charge, i.e., an electron hole, and an electron from an anode plate side at the time of electrical-potential-difference impression, if conditions, like that the place which can recombine these electron holes and an electron can be offered, and luminous efficiency is high are fulfilled, you may be what kind of thing, for example, organic materials, such as a low-molecular fluorochrome, a macromolecule of fluorescence, and a metal complex, etc. will be mentioned. Specifically as such an ingredient, an anthracene, naphthalene, a phenanthrene, a pyrene, a chrysene, perylene, a butadiene, a coumarin, an acridine, a stilbene, a tris (8-quinolinolato) aluminum complex, a bis(benzoquinolinolato) beryllium complex, the Tori (dibenzo ylmethyl) phenanthroline europium complex, a JITORUI ruby nil biphenyl, etc. can be mentioned.

[0016] Electronic transportation layer 22c conveys the electron poured in from the cathode electrode 23 to organic luminous layer 22b. As an usable electronic transportation ingredient, a quinoline, perylene, bis-styryl, pyrazines, or these derivatives can be mentioned to electronic transportation layer 22c. As a concrete compound, 8-hydroxy kino RINARU minium, an anthracene, naphthalene, a phenanthrene, a pyrene, a chrysene, perylene, a butadiene, a coumarin, an acridine, stilbenes, or these derivatives can be illustrated.

[0017] In order to pour an electron into the above-mentioned cathode electrode 23 efficiently, it is desirable to use an electrode material (metal) with the small work function from vacuum level. Specifically, a metal with small work functions, such as aluminum, an indium, magnesium, silver, calcium, barium, and a lithium, is used alone. Or these metals may be used for stability as an alloy with other metals, raising.

[0018] Electron hole transportation layer 22a which constitutes the above-mentioned organic electroluminescence layer 22, organic luminous layer 22b, electronic transportation layer 22c, and the cathode electrode 23 can be formed with a vacuum deposition method.

[0019] It is prepared for securing the dependability of a drive of an organic EL device, and preventing degradation of an organic EL device, and the above-mentioned gas barrier layer 24 closes an organic EL device, and has the function which intercepts oxygen and moisture. Therefore, it is required for it to be possible to maintain airtightness as an ingredient used for the gas barrier layer 24, and, specifically, silicon oxide, silicon nitride, an aluminum oxide, alumimium nitride, etc. can be mentioned.

[0020] If the organic EL device which has the above configuration is arranged in the shape of a matrix on a substrate and this is alternatively driven as a pixel, image display will be possible and a spontaneous light type image display device will be built.

[0021] By the way, although you may stick so that the thin film loudspeaker 3 and the transparence substrate 1 may stick like the above-mentioned example when attaching the above-mentioned thin film loudspeaker 3, it is also possible to give an opening between the transparence substrates 1. Since piezo film 3a which is a diaphragm becomes easy to vibrate by this and it becomes a low-battery drive, the effectiveness as a loudspeaker can be gathered. Drawing 6 shows the example which had a predetermined opening and stuck the thin film loudspeaker on the transparence substrate 1.
[0022] Also in this example, the pixel display 2 is formed on the transparence substrate 1, and although the point that the thin film loudspeaker 3 is stretched by the both-sides section is the same as a previous example, as shown in drawing 6 (b) and drawing 6 (c), it differs that the opening 4 is formed between the thin film loudspeaker 3 and the transparence substrate 1. Here, as for this opening, it is desirable that it is 1cm or less. When an opening is too large, there is a possibility of spoiling flexible nature and portability.
[0023] As mentioned above, although the example of the image display device which applied this invention has been explained, it cannot be overemphasized that this invention is not what is limited to these examples. For example, although each above-mentioned example is an example applied to the organic electroluminescence indicating equipment, as stated also in advance, it is applicable to flat displays at large, such as a liquid crystal display, a plasma display (PDP), and a field emission display (FED). Moreover, it is arbitrary also about the structure of a pixel display or a thin film loudspeaker, and the quality of the material.
[0024]
[Effect of the Invention] According to this invention, it is possible to excel in flexibility and to offer a light and thin loudspeaker built-in image display device (flexible display) so that clearly also from the above explanation. Moreover, the image display device of this invention is easy to carry, and it can install it also in a curved-surface-like wall.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the flexible display using the substrate which has flexibility especially about an image display device.

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PRIOR ART

[Description of the Prior Art] In recent years, research on the flexible display using flexible substrates, such as plastics, is advanced. The flexible display board which carried out the laminating of a gas barrier layer or the transparence conductive layer to transparence plastic film, for example in JP,2000-338901,A etc. as a substrate of this flexible display is indicated. The flexible display has a predominance in lightweight nature, thinness, flexibility, etc. as compared with the display which used the conventional glass substrate, and even if convenient to carry and the wall to fix are curved surfaces, it has advantages, such as being satisfactory.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, it is possible to excel in flexibility and to offer a light and thin loudspeaker built-in image display device (flexible display) so that clearly also from the above explanation. Moreover, the image display device of this invention is easy to carry, and it can install it also in a curved-surface-like wall.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, when using such a flexible display as an image display device-cum-a speech generation device which reproduces voice with an image like a television receiver, the loudspeaker which is sound equipment for generating voice is required.
[0004] Here, as a conventional loudspeaker configuration, although the so-called funnel-like cone mold, a spherical-surface-like dome mold, etc. are common, when it is going to build these loudspeakers in an above-mentioned flexible display, there is a possibility of spoiling the lightweight nature and flexibility which are the advantage of a flexible display. Moreover, when a loudspeaker is made external, carrying etc. is troublesome and there is also a possibility of installing in a curved-surface-like wall becoming difficult and spoiling a fine sight.
[0005] This invention is proposed in view of this conventional actual condition, and it aims at offering the loudspeaker built-in image display device (flexible display) in which lightweight-izing and thin-shape-izing are possible, without spoiling flexibility. Moreover, this invention is easy to carry and it aims at offering the image display device (flexible display) which can be installed also in a curved-surface-like wall.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the image display device of this invention is characterized by building in the thin film loudspeaker which has flexibility. A thin film loudspeaker is lightweight and thin while it has flexibility. By making the thin film loudspeaker which has such a description rival in an image display device (flexible display), flexibility is maintained, image display is possible and the image display device which can also reproduce audio is realized by coincidence. Moreover, taking advantage of the advantage of being thin, lightweight-izing and thin-shape-izing of a display with a built-in loudspeaker are attained by the light weight of a thin film loudspeaker. Since the image display device of this invention contains the thin film loudspeaker and it is not necessary to make a loudspeaker external, carrying is easy. Furthermore, since the flexibility of the image display device itself is maintained, it can install in a curved-surface-like wall etc.

[0007]
[Embodiment of the Invention] Hereafter, the image display device which applied this invention is explained to a detail, referring to a drawing. In addition, although this invention can be applied to various flat-panel displays, such as a liquid crystal display, a plasma display (PDP), an organic electroluminescence display (organic electroluminescence), and a field emission display (FED), an organic electroluminescence display is made into an example and it explains it here.
[0008] Generally the organic EL device used for an organic electroluminescence display is constituted considering the transparent electrode layer on the transparence substrate which has light transmission nature, the organic luminous layer which is formed on this transparent electrode layer and consists of an organic electroluminescence ingredient, and the cathode electrode layer further formed on this organic luminous layer as a fundamental component, and since it has the descriptions, like visibility is high because of a spontaneous light type, it attracts attention as a light emitting device in various displays. In this organic EL device, the electron hole and electron which were poured in from each electrode by the energization to these transparent electrode layer and a cathode electrode layer recombine within an organic luminous layer, and produce luminescence with the energy at this time. Since said luminescence is light emitting diode and similar impregnation luminescence, it is the description that a luminescence electrical potential difference is as low as less than [10V].
[0009] Drawing 1 and drawing 2 show an example of the flexible display which applied this invention. This flexible display makes the thin film loudspeaker 3 come to rival in the both-sides section of the transparence substrate 1 with which laminating formation of the pixel display layer 2 was carried out. The thin film loudspeaker 3 vapor-deposits the electrode layers 3b and 3c which become both sides of piezo film 3a from aluminum etc., and has good flexibility in itself. Thus, since the transparence substrate 1 or not only the pixel display layer 2 but the thin film loudspeaker 3 has flexibility, flexibility good as a whole is maintained, and the flexible display of this example is lightweight, and is thin, and can be stuck on a curved-surface-like wall etc.
[0010] The above-mentioned thin film loudspeaker 3 vapor-deposits the electrode layers 3b and 3c which consist of aluminum etc. as shown in both sides of piezo film 3a shown in drawing 3 (a) at

drawing 3 (b), as stated also in advance. Piezo film 3a is one sort of the piezoelectric film to which the configuration is changed by impressing an electrical potential difference. Here, as for piezo film 3a to be used, it is desirable from playing the role of the diaphragm of a loudspeaker a lightweight thing, especially that thickness is a low consistency thinly. If piezo film 3a is heavy, the imitation nature in a high frequency will worsen. Therefore, PLZT (Pb-La-Zr-Ti system electrostrictive ceramics), the electrostrictive ceramics of LiNbO3 and Bi12Si20 grade, etc. can be used for piezo film 3a. The outstanding loudspeaker of a property can be obtained by forming these electrostrictive ceramics in a uni-morph mold or a bimorph mold at the thin film of glass or plastics.

[0011] Moreover, it is required that the electrode layers 3b and 3c formed as an electrode should have a good electrical property, and electric resistance should be low. Specifically, it is desirable to make the electric resistance of these electrode layers 3b and 3c into below 10ohms / **. If electric resistance is higher than this, driver voltage will go up by the voltage drop, and it will become low effectiveness.

[0012] On the other hand, as shown in drawing 4 , on the transparence substrate 1 which has flexibility, the pixel display 2 is constituted by carrying out sequential membrane formation of the transparent electrode layer 21, the organic electroluminescence layer 22, and the cathode electrode layer 23, and these each class is covered in the gas barrier layer 24, and it is protected from moisture, corrosive gas, etc. The transparence substrate 1 consists of transparence plastic material, such as a polycarbonate and polyethylene terephthalate (PET), etc., and has good flexibility. The above-mentioned transparent electrode layer 21 is formed by forming membranes on this, for example, forming an indium oxide tin (ITO) thin film by the spatter.

[0013] The organic electroluminescence layer 22 is made into the three-tiered structure as shown in drawing 5 , and it consists of electronic transportation layer 22c allotted to the side which touches electron hole transportation layer 22a allotted to the side which touches the above-mentioned transparent electrode layer 21, organic luminous layer 22b, and the above-mentioned cathode electrode 23. In addition, in the above-mentioned configuration, the buffer layer may be formed between the organic electroluminescence layer 22 and the cathode electrode 23. It is formed by forming for example, Li2O by about several angstroms thickness, and this buffer layer can lower luminescence starting potential by this buffer layer.

[0014] Electron hole transportation layer 22a plays the role of conveying the electron hole poured in from the transparent electrode layer 21 to organic luminous layer 22b, among the organic electroluminescence layers 22. As an electron hole transportation ingredient used for this electron hole transportation layer 22a Each well-known thing is usable. Benzine, a styryl amine, A triphenylamine, a porphyrin, triazole, an imidazole, OKISA diazole, the poly aryl alkane, a phenylenediamine, arylamine, oxazole, an anthracene, and full -- me -- non, a hydrazone, and a stilbene -- Or the monomer of heterocycle type conjugated system, such as a polysilane system compound, a vinylcarbazole system compound, a thiophene system compound, and an aniline system compound, oligomer, a polymer, etc. are usable in these derivatives and a list. As a concrete compound, alpha-naphthylphenyl diamine, a porphyrin, A metal tetra-phenyl porphyrin, metal naphthalocyanine, 4 and 4, 4-tris (3-methylphenyl phenylamino) triphenylamine, N, N, N, and N-tetrakis (p-tolyl) p-phenylene diamine, Although the N, N, N, and N-tetra-phenyl 4, 4-diamino biphenyl, N-phenyl carbazole, a 4-G p-tolylamino stilbene, Pori (PARAFENIREMBINIREN), Pori (thiophene vinylene), Pori (2 and 2-thienyl pyrrole), etc. can be mentioned Of course, it is not limited to these.

[0015] The ingredient used for organic luminous layer 22b moves that a cathode side to an electron can be poured in for an electron hole again and the poured-in charge, i.e., an electron hole, and an electron from an anode plate side at the time of electrical-potential-difference impression, if conditions, like that the place which can recombine these electron holes and an electron can be offered, and luminous efficiency is high are fulfilled, you may be what kind of thing, for example, organic materials, such as a low-molecular fluorochrome, a macromolecule of fluorescence, and a metal complex, etc. will be mentioned. Specifically as such an ingredient, an anthracene, naphthalene, a phenanthrene, a pyrene, a chrysene, perylene, a butadiene, a coumarin, an acridine, a stilbene, a tris (8-quinolinolato) aluminum complex, a bis(benzoquinolinolato) beryllium complex, the Tori (dibenzo ylmethyl) phenanthroline

europium complex, a JITORUI ruby nil biphenyl, etc. can be mentioned.
[0016] Electronic transportation layer 22c conveys the electron poured in from the cathode electrode 23 to organic luminous layer 22b. As an usable electronic transportation ingredient, a quinoline, perylene, bis-styryl, pyrazines, or these derivatives can be mentioned to electronic transportation layer 22c. As a concrete compound, 8-hydroxy kino RINARU minium, an anthracene, naphthalene, a phenanthrene, a pyrene, a chrysene, perylene, a butadiene, a coumarin, an acridine, stilbenes, or these derivatives can be illustrated.
[0017] In order to pour an electron into the above-mentioned cathode electrode 23 efficiently, it is desirable to use an electrode material (metal) with the small work function from vacuum level. Specifically, a metal with small work functions, such as aluminum, an indium, magnesium, silver, calcium, barium, and a lithium, is used alone. Or these metals may be used for stability as an alloy with other metals, raising.
[0018] Electron hole transportation layer 22a which constitutes the above-mentioned organic electroluminescence layer 22, organic luminous layer 22b, electronic transportation layer 22c, and the cathode electrode 23 can be formed with a vacuum deposition method.
[0019] It is prepared for securing the dependability of a drive of an organic EL device, and preventing degradation of an organic EL device, and the above-mentioned gas barrier layer 24 closes an organic EL device, and has the function which intercepts oxygen and moisture. Therefore, it is required for it to be possible to maintain airtightness as an ingredient used for the gas barrier layer 24, and, specifically, silicon oxide, silicon nitride, an aluminum oxide, alumimium nitride, etc. can be mentioned.
[0020] If the organic EL device which has the above configuration is arranged in the shape of a matrix on a substrate and this is alternatively driven as a pixel, image display will be possible and a spontaneous light type image display device will be built.
[0021] By the way, although you may stick so that the thin film loudspeaker 3 and the transparence substrate 1 may stick like the above-mentioned example when attaching the above-mentioned thin film loudspeaker 3, it is also possible to give an opening between the transparence substrates 1. Since piezo film 3a which is a diaphragm becomes easy to vibrate by this and it becomes a low-battery drive, the effectiveness as a loudspeaker can be gathered. Drawing 6 shows the example which had a predetermined opening and stuck the thin film loudspeaker on the transparence substrate 1.
[0022] Also in this example, the pixel display 2 is formed on the transparence substrate 1, and although the point that the thin film loudspeaker 3 is stretched by the both-sides section is the same as a previous example, as shown in drawing 6 (b) and drawing 6 (c), it differs that the opening 4 is formed between the thin film loudspeaker 3 and the transparence substrate 1. Here, as for this opening, it is desirable that it is 1cm or less. When an opening is too large, there is a possibility of spoiling flexible nature and portability.
[0023] As mentioned above, although the example of the image display device which applied this invention has been explained, it cannot be overemphasized that this invention is not what is limited to these examples. For example, although each above-mentioned example is an example applied to the organic electroluminescence indicating equipment, as stated also in advance, it is applicable to flat displays at large, such as a liquid crystal display, a plasma display (PDP), and a field emission display (FED). Moreover, it is arbitrary also about the structure of a pixel display or a thin film loudspeaker, and the quality of the material.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline top view showing an example of the image display device which applied this invention.
[Drawing 2] It is the outline sectional view of the image display device shown in drawing 1 .
[Drawing 3] It is the outline sectional view in which showing the example of a configuration of a thin film loudspeaker, and showing the condition that (a) carried out the outline sectional view of a piezo film, and (b) carried out the laminating of the electrode.
[Drawing 4] It is the outline sectional view showing the example of a configuration of a pixel display.
[Drawing 5] It is the mimetic diagram showing the example of a configuration of an organic electroluminescence layer.
[Drawing 6] The example which prepared the opening between the thin film loudspeaker and the transparence substrate is shown, and an outline sectional view [in / (a) and / in (b) / the x-x'line of (a)] and (c) are the outline sectional views in the y-y'line of (a). [an outline top view]
[Description of Notations]
1 Transparence Substrate, 2 Pixel Display, 3 Thin Film Loudspeaker, 3a Piezo Film, 3B, 3C Electrode Layer, 4 Opening, 22 Organic Electroluminescence Layer, 22a Electron Hole Transportation Layer, 22B Organic Luminous Layer, 22C Electronic Transportation Layer

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[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2003－125315
（P2003－125315A）
(43)公開日　平成15年４月25日(2003.4.25)

(51)Int.Cl.'		識別記号	FI			テーマコード(参考)
H04N	5/70		H04N	5/70	Z	2H088
G02F	1/13	505	G02F	1/13	505	2H090
	1/1333	500		1/1333	500	5C058
G09F	9/00	346	G09F	9/00	346A	5C094
	9/30	365		9/30	365Z	5G435

審査請求　未請求　請求項の数13　ＯＬ　（全６頁）

(21)出願番号　特願2001－321599(P2001－321599)

(22)出願日　平成13年10月19日(2001.10.19)

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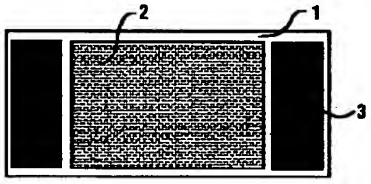
(54)【発明の名称】　画像表示装置

(57)【要約】
【課題】　フレキシブルディスプレイにおいて、可撓性を損なうことなく音声の再生を可能とし、軽量化や薄型化を可能とする。
【解決手段】　可撓性を有する薄膜スピーカを内蔵する画像表示装置である。薄膜スピーカは、例えば、圧電性フィルムを振動板とし、その両面に電極シートを貼り合わせたものである。薄膜スピーカは、基板との間に空隙を有していてもよい。液晶表示装置、プラズマディスプレイ（ＰＤＰ）、有機エレクトロルミネッセンス表示装置（有機ＥＬ）、フィールドエミッションディスプレイ（ＦＥＤ）等、各種フラットパネルディスプレイに適用される。



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【特許請求の範囲】
【請求項1】　可撓性を有する薄膜スピーカを内蔵することを特徴とする画像表示装置。
【請求項2】　上記薄膜スピーカは、圧電性フィルムを振動板とすることを特徴とする請求項1記載の画像表示装置。
【請求項3】　上記薄膜スピーカは、圧電性フィルムの両面に電極シートを貼り合わせたものであることを特徴とする請求項2記載の画像表示装置。
【請求項4】　上記電極シートのシート抵抗が10Ω/□以下であることを特徴とする請求項3記載の画像表示装置。
【請求項5】　上記薄膜スピーカの厚さが1cm以下であることを特徴とする請求項1記載の画像表示装置。
【請求項6】　基板上に画素が配列されてなり、前記基板が可撓性を有することを特徴とする請求項1記載の画像表示装置。
【請求項7】　上記基板がプラスチックフィルムからなることを特徴とする請求項6記載の画像表示装置。
【請求項8】　上記薄膜スピーカと上記基板との間に空隙を有することを特徴とする請求項6記載の画像表示装置。
【請求項9】　上記薄膜スピーカと上記基板の間隔は1cm以下であることを特徴とする請求項8記載の画像表示装置。
【請求項10】　上記画素は、有機エレクトロルミネッセンス素子により構成されていることを特徴とする請求項6記載の画像表示装置。
【請求項11】　上記有機エレクトロルミネッセンス素子は、少なくとも第1電極、有機発光層、第2電極が順次積層されてなることを特徴とする請求項10記載の画像表示装置。
【請求項12】　上記有機発光層の陽極となる電極側に正孔輸送層が配されていることを特徴とする請求項11記載の画像表示装置。
【請求項13】　上記有機発光層の陰極となる電極側に電子輸送層が配されていることを特徴とする請求項11記載の画像表示装置。
【発明の詳細な説明】
【0001】
【発明の属する技術分野】本発明は、画像表示装置に関するものであり、特に、可撓性を有する基板を用いたフレキシブルディスプレイに関するものである。
【0002】
【従来の技術】近年、プラスチック等の可撓性基板を用いたフレキシブルディスプレイに関する研究が進められている。かかるフレキシブルディスプレイの基板としては、例えば特開2000-338901等において透明プラスチックフィルムにガスバリア層や透明導電層を積層したフレキシブルディスプレイ基板が開示されている。フレキシブルディスプレイは、従来のガラス基板を用いたディスプレイと比較して、軽量性、薄さ、可撓性等において優位性を持っており、持ち運びに便利であること、固定する壁が曲面であっても問題がないこと等の利点を有する。

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【0003】
【発明が解決しようとする課題】ところで、このようなフレキシブルディスプレイを、テレビジョン受像機等のように画像と共に音声を再生する画像表示装置兼音声発生装置として使用する場合、音声を発生するための音響装置であるスピーカが必要である。
【0004】ここで、従来のスピーカ形状としては、漏斗状のいわゆるコーン型や、球面状のドーム型等が一般的であるが、これらのスピーカを上述のフレキシブルディスプレイに内蔵しようとすると、フレキシブルディスプレイの長所である軽量性や可撓性を損なう虞れがある。また、スピーカを外付けにした場合、持ち運び等が面倒であり、曲面状の壁に設置することが難しくなり美観を損ねる虞れもある。
【0005】本発明は、かかる従来の実情に鑑みて提案されたものであり、可撓性を損なうことなく軽量化や薄型化が可能なスピーカ内蔵型の画像表示装置（フレキシブルディスプレイ）を提供することを目的とする。また、本発明は、持ち運びが容易で、曲面状の壁にも設置可能な画像表示装置（フレキシブルディスプレイ）を提供することを目的とする。
【0006】
【課題を解決するための手段】上述の目的を達成するために、本発明の画像表示装置は、可撓性を有する薄膜スピーカを内蔵することを特徴とするものである。薄膜スピーカは、可撓性を有するとともに、軽量で薄い。このような特徴を有する薄膜スピーカを画像表示装置（フレキシブルディスプレイ）に張り合わせることによって、可撓性を維持し、画像表示が可能で、同時に音声の再生も可能な画像表示装置が実現される。また、薄膜スピーカの軽量で薄いという利点を活かして、スピーカ内蔵ディスプレイの軽量化や薄型化が達成される。本発明の画像表示装置は、薄膜スピーカを内蔵しており、スピーカを外付けにする必要がないため、持ち運びが容易である。さらに、画像表示装置自体の可撓性が維持されるので、曲面状の壁等にも設置可能である。
【0007】
【発明の実施の形態】以下、本発明を適用した画像表示装置について、図面を参照しながら詳細に説明する。なお、本発明は、液晶表示装置、プラズマディスプレイ（PDP）、有機エレクトロルミネッセンス表示装置（有機EL）、フィールドエミッションディスプレイ（FED）等、各種フラットパネルディスプレイに適用することが可能であるが、ここでは有機EL表示装置を例にして説明する。

【0008】有機ＥＬ表示装置に用いられる有機ＥＬ素子は、一般に、光透過性を有する透明基板上の透明電極層と、この透明電極層上に形成され有機ＥＬ材料からなる有機発光層と、さらにこの有機発光層上に形成されたカソード電極層とを基本的な構成要素として構成されており、自発光型のため視認性が高い等の特徴を有することから、各種表示装置における発光素子として注目を集めている。この有機ＥＬ素子においては、これら透明電極層及びカソード電極層への通電により、それぞれの電極から注入された正孔及び電子が有機発光層内で再結合し、このときのエネルギーにより発光現象を生ずる。前記発光現象は、発光ダイオードと類似した注入発光であるため、発光電圧が１０Ｖ以下と低いことが特徴である。

【0009】図１及び図２は、本発明を適用したフレキシブルディスプレイの一例を示すものである。このフレキシブルディスプレイは、画素表示層２が積層形成された透明基板１の両側部に、薄膜スピーカ３を張り合わせてなるものである。薄膜スピーカ３は、ピエゾフィルム３ａの両面にアルミニウム等からなる電極層３ｂ、３ｃを蒸着したものであり、それ自体、良好な可撓性を有する。このように、本例のフレキシブルディスプレイは、透明基板１や画素表示層２のみならず薄膜スピーカ３も可撓性を有しているため、全体として良好な可撓性が維持され、軽量で薄く、且つ曲面状の壁等にも張り付けることが可能である。

【0010】上記薄膜スピーカ３は、先にも述べたように、図３（ａ）に示すピエゾフィルム３ａの両面に図３（ｂ）に示すようにアルミニウム等からなる電極層３ｂ，３ｃを蒸着したものである。ピエゾフィルム３ａは、電圧を印加することによりその形状を変化させる圧電性フィルムの１種である。ここで、用いるピエゾフィルム３ａは、スピーカの振動板の役割を果たすことから、軽量であること、特に厚さが薄く低密度であることが好ましい。ピエゾフィルム３ａが重いと、高い周波数での追随性が悪くなる。したがって、ピエゾフィルム３ａには、例えばＰＬＺＴ（Ｐｂ－Ｌａ－Ｚｒ－Ｔｉ系圧電セラミックス）や、$LiNbO_3$、$Bi_{12}Si_{20}$等の圧電セラミックス等を使用することができる。これら圧電セラミックスを、例えばガラスやプラスチックの薄膜にユニモルフ型、あるいはバイモルフ型に成膜することにより、優れた特性のスピーカを得ることができる。

【0011】また、電極として形成される電極層３ｂ，３ｃは、電気特性が良好で、電気抵抗が低いことが要求される。具体的には、これら電極層３ｂ，３ｃの電気抵抗を１０Ω／□以下とすることが望ましい。これよりも電気抵抗が高いと、電圧降下により駆動電圧が上昇し、低効率となってしまう。

【0012】一方、画素表示部２は、図４に示すように、可撓性を有する透明基板１上に、透明電極層２１、有機ＥＬ層２２、カソード電極層２３を順次成膜することにより構成されており、これら各層がガスバリア層２４で覆われ、水分や腐食性ガス等から保護されている。透明基板１は、例えばポリカーボネートやポリエチレンテレフタレート（ＰＥＴ）等の透明プラスチック材料等からなり、良好な可撓性を有する。上記透明電極層２１は、この上に成膜され、例えば酸化インジウム錫（ＩＴＯ）薄膜をスパッタ法で成膜することにより形成される。

【0013】有機ＥＬ層２２は、図５に示すように３層構造とされており、上記透明電極層２１と接する側に配される正孔輸送層２２ａ、有機発光層２２ｂ、及び上記カソード電極２３と接する側に配される電子輸送層２２ｃとから構成されている。なお、上記の構成において、有機ＥＬ層２２とカソード電極２３の間にバッファ層が形成されていてもよい。このバッファ層は、例えばLi_2Oを数オングストローム程度の膜厚で成膜することにより形成されるもので、このバッファ層により発光開始電圧を下げることが可能である。

【0014】有機ＥＬ層２２のうち、正孔輸送層２２ａは、透明電極層２１から注入された正孔を有機発光層２２ｂまで輸送するという役割を果たすものである。この正孔輸送層２２ａに用いられる正孔輸送材料としては、公知のものがいずれも使用可能であり、ベンジン、スチリルアミン、トリフェニルアミン、ポルフィリン、トリアゾール、イミダゾール、オキサジアゾール、ポリアリールアルカン、フェニレンジアミン、アリールアミン、オキサゾール、アントラセン、フルオレノン、ヒドラゾン、スチルベン、またはこれらの誘導体、並びにポリシラン系化合物、ビニルカルバゾール系化合物、チオフェン系化合物、アニリン系化合物等の複素環式共役系のモノマー、オリゴマー、ポリマー等が使用可能である。具体的化合物としては、α－ナフチルフェニルジアミン、ポルフィリン、金属テトラフェニルポルフィリン、金属ナフタロシアニン、４，４，４－トリス（３－メチルフェニルフェニルアミノ）トリフェニルアミン、Ｎ，Ｎ，Ｎ，Ｎ－テトラキス（ｐ－トリル）ｐ－フェニレンジアミン、Ｎ，Ｎ，Ｎ，Ｎ－テトラフェニル４，４－ジアミノビフェニル、Ｎ－フェニルカルバゾール、４－ジ－ｐ－トリルアミノスチルベン、ポリ（パラフェニレンビニレン）、ポリ（チオフェンビニレン）、ポリ（２，２－チエニルピロール）等を挙げることができるが、勿論これらに限定されるものではない。

【0015】有機発光層２２ｂに用いられる材料は、電圧印加時に陽極側から正孔を、また陰極側から電子を注入できること、注入された電荷、すなわち正孔及び電子を移動させ、これら正孔と電子が再結合できる場を提供できること、発光効率が高いこと、等の条件を満たしていれば如何なるものであってもよく、例えば低分子蛍光

色素、蛍光性の高分子、金属錯体等の有機材料等が挙げられる。このような材料としては、具体的には、アントラセン、ナフタリン、フェナントレン、ピレン、クリセン、ペリレン、ブタジエン、クマリン、アクリジン、スチルベン、トリス（8－キノリノラト）アルミニウム錯体、ビス（ベンゾキノリノラト）ベリリウム錯体、トリ（ジベンゾイルメチル）フェナントロリンユーロピウム錯体、ジトルイルビニルビフェニル等を挙げることができる。

【0016】電子輸送層22cは、カソード電極23から注入された電子を有機発光層22bまで輸送するものである。電子輸送層22cに使用可能な電子輸送材料としては、キノリン、ペリレン、ビススチリル、ピラジン、またはこれらの誘導体を挙げることができる。具体的化合物としては、8－ヒドロキシキノリンアルミニウム、アントラセン、ナフタリン、フェナントレン、ピレン、クリセン、ペリレン、ブタジエン、クマリン、アクリジン、スチルベン、またはこれらの誘導体等を例示することができる。

【0017】上記カソード電極23には、効率良く電子を注入するために、真空準位からの仕事関数が小さい電極材料（金属）を用いることが好ましい。具体的には、アルミニウム、インジウム、マグネシウム、銀、カルシウム、バリウム、リチウム等の仕事関数が小さい金属を単体で用いる。あるいは、これらの金属を他の金属との合金として安定性を高めて使用してもよい。

【0018】上記有機EL層22を構成する正孔輸送層22a、有機発光層22b、電子輸送層22cや、カソード電極23は、例えば真空蒸着法により形成することができる。

【0019】上記ガスバリア層24は、有機EL素子の駆動の信頼性を確保し、また有機EL素子の劣化を防止するための設けられるもので、有機EL素子を封止し、酸素や水分を遮断する機能を有するものである。したがって、ガスバリア層24に用いられる材料としては、気密性を保つことが可能であることが必要であり、具体的には、酸化シリコン、窒化シリコン、酸化アルミニウム、窒化アルミニウム等を挙げることができる。

【0020】以上の構成を有する有機EL素子を基板上にマトリクス状に配列し、これを画素として選択的に駆動すれば画像表示が可能であり、自発光型の画像表示装置が構築される。

【0021】ところで、上記薄膜スピーカ3を取り付ける場合、上記の例のように薄膜スピーカ3と透明基板1とが密着するように張り付けてもよいが、透明基板1との間に空隙を持たせることも可能である。これにより、振動板であるピエゾフィルム3aが振動し易くなり、低電圧駆動となるためスピーカとしての効率を上げることができる。図6は、薄膜スピーカを所定の空隙をもって透明基板1に張り付けた例を示すものである。

【0022】本例においても、透明基板1上に画素表示部2が形成され、その両側部に薄膜スピーカ3が張り合わされている点は先の例と同じであるが、図6（b）及び図6（c）に示すように、薄膜スピーカ3と透明基板1の間に空隙4が形成されていることが異なる。ここで、この空隙は1cm以下であることが好ましい。空隙が大きすぎると、フレキシブル性や携帯性を損なう虞れがある。

【0023】以上、本発明を適用した画像表示装置の具体例について説明してきたが、本発明がこれらの例に限定されるものでないことは言うまでもない。例えば、上記の例はいずれも有機EL表示装置に適用した例であるが、先にも述べたように、液晶表示装置、プラズマディスプレイ（PDP）、フィールドエミッションディスプレイ（FED）等、フラットディスプレイ全般に適用可能である。また、画素表示部や薄膜スピーカの構造、材質等についても任意である。

【0024】

【発明の効果】以上の説明からも明らかなように、本発明によれば、可撓性に優れ、軽量且つ薄型のスピーカ内蔵型画像表示装置（フレキシブルディスプレイ）を提供することが可能である。また、本発明の画像表示装置は、持ち運びが容易であり、曲面状の壁にも設置可能である。

【図面の簡単な説明】

【図1】本発明を適用した画像表示装置の一例を示す概略平面図である。

【図2】図1に示す画像表示装置の概略断面図である。

【図3】薄膜スピーカの構成例を示すものであり、（a）はピエゾフィルムの概略断面図、（b）は電極を積層した状態を示す概略断面図である。

【図4】画素表示部の構成例を示す概略断面図である。

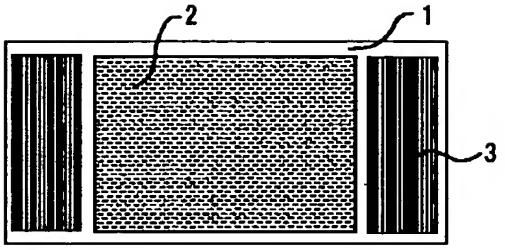
【図5】有機EL層の構成例を示す模式図である。

【図6】薄膜スピーカと透明基板の間に空隙を設けた例を示すものであり、（a）は概略平面図、（b）は（a）のx－x´線における概略断面図、（c）は（a）のy－y´線における概略断面図である。

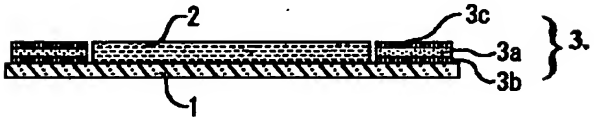
【符号の説明】

1　透明基板、2　画素表示部、3　薄膜スピーカ、3a　ピエゾフィルム、3b，3c　電極層、4　空隙、22　有機EL層、22a　正孔輸送層、22b有機発光層、22c　電子輸送層

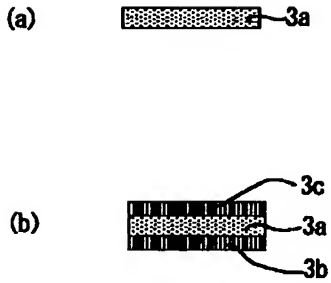
【図1】



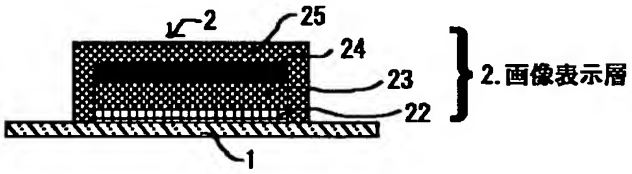
【図2】



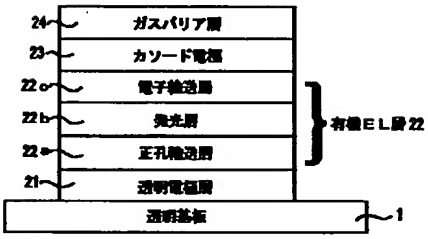
【図3】



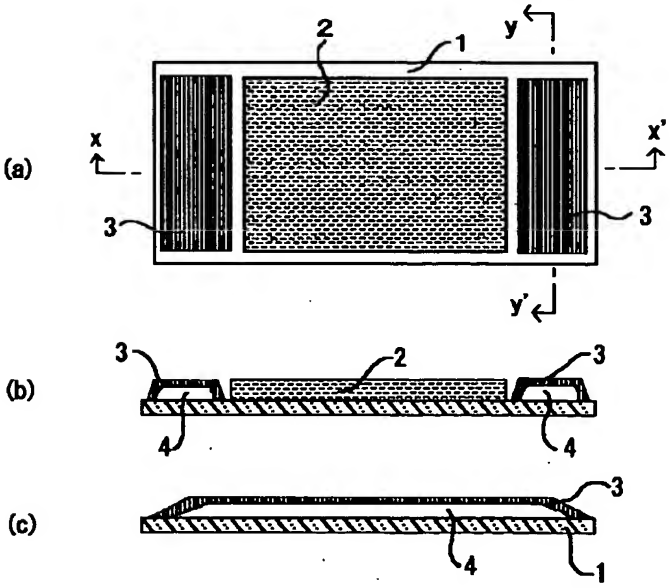
【図4】



【図5】



【図6】



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Ｆターム(参考)　2H088 EA02 HA01 HA05 MA20
2H090 JA06 JB03 JD11
5C058 AA12 AB06
5C094 AA15 BA27 BA43 DA06 HA08
5G435 AA18 BB05 BB06 BB12 EE10
EE11 LL04